

I claim:

1. A tunable electron device providing electromagnetic radiation at broad frequency operating ranges, the device comprising:
  - an electron gun injecting an electron beam to travel within a device interaction region in an axial direction;
  - a wiggler field system providing a first magnetic field causing the electron beam to travel in a helical trajectory along the axial direction;
  - an axial magnetic field system providing a second magnetic field in the direction opposite to the axial direction; and
  - a control system connected to the axial magnetic field system, electron gun, and wiggler field system, said control system causing parametric synchronism of the different eigen modes within the electron beam.
2. The device of claim 1, wherein the electrons within the electron beam travel at non-relativistic velocity.
3. The device of claim 1, wherein the eigen modes include cyclotron waves and space charge waves.
4. The device of claim 1, wherein the control system controls the electron gun to provide constant beam energy while said device operates at varying output frequency ranges.

5. The device of claim 1, wherein the control system controls the relative strengths of the first and second magnetic fields to vary the device's operating frequency.

6. The device of claim 1, further comprising a device resonator to vary the device's operating frequency.